Distal radial fractures outcome in relation to instability markers

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Background
Fractures of the distal radius are common, especially in elderly patients. Treatment consists of closed reduction and immobilization. Long-term effects of malunion indicate surgery for potentially unstable fractures.
Patients and methods
A prospective study was conducted in 60 patients with a distal radius fracture between February 2012 and January 2013 and matched with criteria included in this study. The strategy of management was subdivided into plaster cast immobilization with subsequent rehabilitation, manipulation with subsequent cast immobilization, and surgery (volar plating). Outcomes were graded as good or poor based on the complications and the function achieved at the end of follow-up.
Results
A total of 60 patients were included in the study. Thirty five patients had less than or equal to 3 instability markers (group A) and 25 had more than or equal to 4 (group B). Overall, 42 were female and 18 were male. The average age was 58 years, with an age range of 20–65 years, in group A, whereas the average age was 57 years, with an age range of 21–63 years, in group B.
Conclusion
Presence of four or more instability markers is globally associated with a poorer outcome. Patients with four or more markers who underwent surgery did uniformly better than those with manipulation alone. In patients with three or fewer markers, nonoperative management achieved good outcomes.

Keywords:
instability markers, radial fractures, outcome

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Introduction

Lafontaine *et al*. [1] reported that age more than 60 years, dorsal angulation (>20°), dorsal comminution, intra-articular fracture (radio carpal joint surface), and associated ulnar fracture were associated with an increased risk of secondary displacement, despite a correct initial reduction.

Jenkins [2] showed that fracture position at presentation was an important indicator of the fracture position at union. Fractures of the distal radius are extremely common and account for 20% of all fractures at the emergency. There is a bimodal age distribution of incidence, with the adolescent and elderly populations being the most affected [3]. These fractures occur more commonly in women than men, occur with increasing frequency with increasing age, and result more commonly from low-energy falls than from high-energy trauma. The standard of treatment for most fractures of the distal radius remains closed reduction and immobilization. Surgical intervention should be considered when an acceptable reduction cannot be achieved or [4] maintained by closed means [5]. Instability is defined as the inability of a fracture to resist displacement after it has been manipulated into an anatomic position. Cooney *et al*. [6] considered fractures widely displaced with extensive dorsal comminution, dorsal angulation greater than 20°, or extensive intra-articular involvement to have a significant chance of redisplacement after reduction.

Weber [7] extended this concept to include fractures with dorsal comminution that extended volar to the mid axial plane of the radius on the lateral radiograph. Abbaszadegan *et al*. [8] suggested that instability is present if the initial radiograph reveals more than 4 mm of radial shortening. Lafontaine *et al*. [1] suggested five factors that indicated instability :(a) initial dorsal angulation greater than 20°, (b) dorsal comminution, (c) radio carpal intra-articular involvement, (d) associated ulna fractures, and (e) age greater than 60 years. Radiological evaluation on anteroposterior and lateral radiography is illustrated in Fig. 1.

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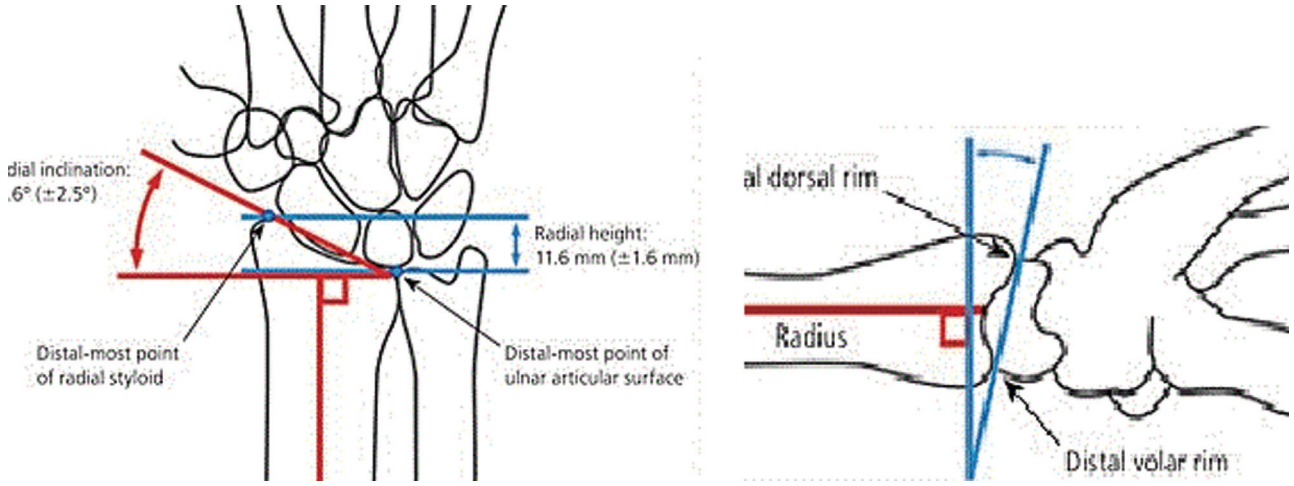
Figure 1



Radiological assessment of distal radius measurements. Volar tilt 11.2±12.

Patients and methods

This study was conducted at Zagazig University Hospital between February 2012 and January 2013. All patients operated after consent and under ethical committee of Zagazig University IRP. A total of 60 patients were included in this study. Thirty five patients had less than or equal to 3 instability markers (group A) and 25 had more than or equal to 4 (group B). Overall, 42 were female and 18 were male. The average age was 58 years, with an age range of 20–65 years, in group A, whereas the average age was 57 years, with an age range of 21–63 years, in group B. Exclusion criteria in this study were ipsilateral limb injuries, multiple injuries, bilateral wrist fractures, volar angulated fractures, severe systemic illness, open fractures, and previous fracture in the same wrist. For results as regard instability markers of stability for distal radial fractures. The following markers of instability for distal radial fractures were identified: age more than 60 years, dorsal angulations more than 20°, intra-articular fracture, ulna fracture, dorsal comminution, radial shortening of greater than 2 mm, and osteoporosis. Table 1 recorded patient demographics, the number and type of instability markers, the management strategy used, and patient outcomes. Patients were grouped according to the management strategies into the following: plaster cast immobilization with subsequent rehabilitation, manipulation with subsequent cast immobilization, and surgery (Fig. 2).

Surgical treatment

The standard volar approach was used with the incision centered over the flexor carpi radialis tendon. The tendon is retracted and the bed of the muscle is incised and retracted. The pronator quadratus muscle is lifted of the volar surface of the distal radius. The fracture is identified and reduced, and the plate applied on the volar aspect under the guidance of the image intensifier. The wound was closed with suction and cast.

Table 1 The instability markers for radius fracture

Number	Instability markers
1	Age >60 years
2	Dorsal angulations >20 deg.
3	Intra-articular fracture
4	Ulna fracture
5	Dorsal comminutions
6	Radial shortening of >2 mm
7	Osteoporosis

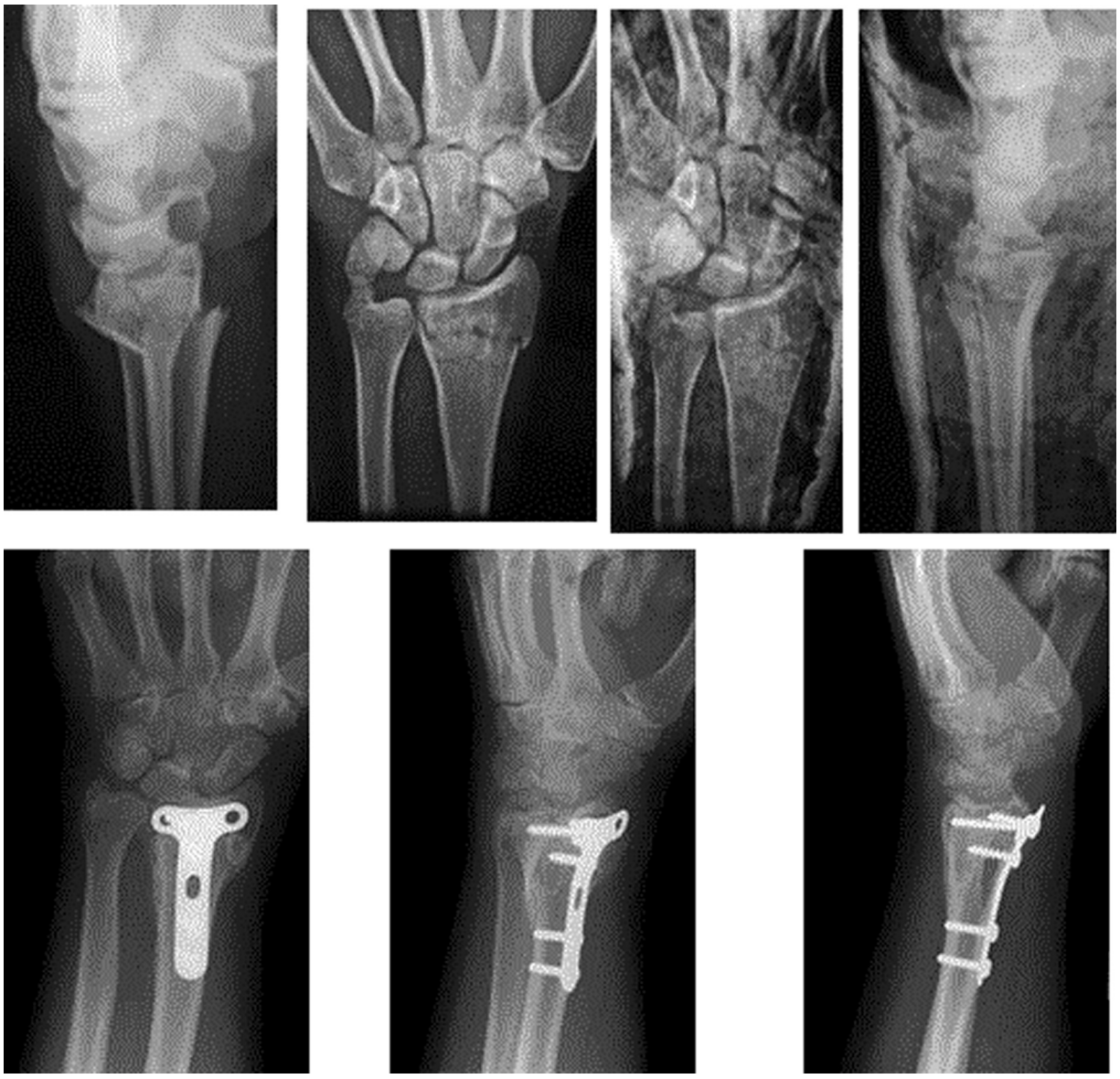
Statistical analysis

The following statistical methods were used for analysis of results of the present study. Data were checked, entered, and analyzed using SPSS version 19 (SPSS Inc., Chicago, Illinois, USA) used in Windows 7 for data processing and statistic. The analyses are illustrated in Tables 6–9.

Results

Functional outcome was assessed regarding the range of motion (ROM) achieved and the ability to carry out activities of daily living (ADLs). ADLs were subjectively assessed by recording patient's ability to do household work such as shopping, cooking, cleaning, opening a jar, and using a knife and fork. The outcome was graded as good if patients were satisfied with their ability to undertake ADLs and achieved an acceptable ROM. Outcome was poor if patients were still unable to satisfactorily undertake their ADLs. Radiographic outcome targets were volar tilt restored (within 10°),

Figure 2



(a, b) Unstable distal radius fracture in anteroposterior and lateral view. (c, d) Closed reduction, casting with redisplacement. (e–g) Plate fixation with good healing.

Table 2 Comparison of demographics between group A and group B

	Group A	Group B
Number of patients	35	25
Male : female	13–22	5–20
Average age (years)	58	57
Age range (years)	20–65	21–63

Table 3 Patients with less than or equal to 3 instability markers (group A)

Management	Number of patients	Good outcome [*n* (%)]	Poor outcome [*n* (%)]
Plaster cast immobilization only	19	16 (84.2)	3 (15.7)
Manipulation	8	6 (75)	2 (25)
Surgery	8	7 (87.5)	1 (12.5)

radial length within 2 mm, radial inclination within 5°, and articular step-off less than 2 mm. Patients who failed to achieve these parameters but were still able to achieve good functional outcome, then overall outcome was still deemed as good. Patients were divided into two groups: group A had less than or equal to three instability markers and group B had more than or equal to four. The outcomes of conservative management and surgical fixation between these two groups were compared. In total, 60 patients were included in this study, where 42 were female and 18 were male. The average age was 58 years, with an age range of 20–65 years, in group A, whereas the average age was 57 years, with an age range of 21–63 years, in group B. Group A had 35 patients with less than or equal to three instability markers and group B

Table 4 Patients with more than or equal to 4 instability markers (group B)

Management	Number of patients	Good outcome [*n* (%)]	Poor outcome [*n* (%)]
Plaster cast immobilization only	12	5 (41.6)	7 (58.3)
Manipulation	6	4 (66.5)	2 (33.3)
Surgery	7	5 (71.4)	2 (28.5)

had 25 patients with more than or equal to four instability markers (Table 2). As shown in Table 3, among the patients with less than or equal to three instability markers (group A), 19 patients were treated with plaster immobilization and subsequent rehabilitation, without any manipulation or surgery. Of these, 16 (84.2%) patients had a 'good' outcome and four (15.8%) had a 'poor' outcome. Eight patients had either one or multiple manipulations without subsequent surgery, where six (75%) had a 'good' outcome and two (25%) had a 'poor' outcome. Of the eight patients who had surgery, seven (87.5%) had a 'good' outcome and one (12.5%) had a 'poor' outcome. In group B ($\geq$ 4 instability markers), of the 25 patients (Table 4), 12 patients were treated with plaster immobilization and subsequent rehabilitation without any manipulation or surgery. Five (41.6%) patients achieved a 'good' outcome, whereas seven (58.3%) achieved a 'poor' outcome. Six patients were treated with one or multiple manipulations without subsequent surgery, among whom four (66.5%) had a 'good' outcome and two (33.3%) had a 'poor' outcome. Among the seven patients who underwent surgery, five (71.4%) achieved a 'good' outcome, whereas two (28.5%) patients had a 'poor' outcome. In group A ($\leq$ 3 instability markers), 82.86% achieved a 'good' outcome regardless of the management strategy used as compared with 56% in group B ($\geq$ 4 instability markers). Poor results were 17.14% in group A in comparison with 44% in group B (Table 5).

Table 5 Patients' final results

Total results	Good (%)	Poor (%)
Group A	82.9	17.1
Group B	56	44

Discussion

Results of this study demonstrated that four or more instability markers in distal radial fractures are associated with a poorer outcome. Patients with four or more instability markers did better with surgery. Those individuals who underwent surgical fixation in group B were more likely to regain a satisfactory ROM and be able to return to their pre-injury ADL. Koenig *et al.* [9] showed that in potentially unstable distal radial fractures treated with locked volar plating, the probability of painless union was higher. Figl *et al.* [10] reported that the treatment of unstable distal radial fractures with a volar fixed-angle plate osteosynthesis in elderly patients showed good anatomical reduction, early return to function, and reduced morbidity. Secondary loss of reduction was also prevented by this procedure. Orbay and Fernandez [11] found similar results, who reported that treatment of unstable distal radial fractures in elderly patients with volar fixed-angle plate provided a more stable fixation and earlier return to function. The complications of volar locking plates are well documented. Drobetz and Kutscha-Lissberg [12] found flexor pollicis longus tendon rupture as the most common complication. Arora *et al.* [13] reported that in palmar fixed-angle plates, if the screws are too long, then they can penetrate the extensor compartments and that distal screws in comminuted fractures can cut through the subchondral bone and penetrate into the radio carpal joint. Knight *et al.* [14] studied 40 patients with volar locking plates, of which 25% had malunion and 12.5% had rupture of the extensor pollicis longus tendon. Closed reduction in 60 distal radial fractures in the very elderly and low-demand patients showed that 53/60 (88%) healed in the malunited position. Beumer and McQueen [15] reported a little benefit in manipulating these fractures, as the position is rarely maintained. If they are unfit for surgery, they are best treated by plaster immobilization and follow-up. In this study, we found that most patients in the group with four or more instability markers who were not manipulated or operated upon were low-demand frail and elderly patients and they did reasonably well with plaster cast immobilization only. Arora *et al.* [16] compared operative versus nonoperative treatment for unstable distal radial fractures in low-demand patients 70 years or older. They found that surgery yielded better radiological outcome, but there was no significant difference in the functional outcome between the operative and nonoperative groups. In this study, the results showed that functional outcome is better in the surgical group as compared with the nonoperative group in the patients with four or more instability markers. There is still no consensus regarding the best treatment option for unstable distal radial fractures (DRFs) in the elderly individuals, as reported by Handoll, Handoll HH, Madhok R. Withdrawn [17]. Stable and reducible Colles fractures, which do not redisplace in a cast in the first 10 days after reduction, are treated nonoperatively with satisfactory radiological and

Table 6 Comparison of demographics between group A and group B

Average age (years)	Group A (*N*=35) [*n* (%)]		Group B (*N*=25) [*n* (%)]		χ^2	*P* value
Sex						
Male	13 (37.1)		5 (20.0)		2.04	0.153
Female	22 (62.9)		20 (80.0)			
Age (years)	Mean±SD	Range	Mean±SD	Range	*t*	*P* value
	19±58	20.65	18±57	21.63	0.04	0.838

Table 7 Patients with less than or equal to 3 instability markers (group A)

Management	Number of patients	Good outcome [*n* (%)]	Poor outcome [*n* (%)]	χ^2	*P* value
Plaster cast immobilization only	19	16 (84.2)	3 (15.7)	0.49	0.781
Manipulation	8	6 (75)	2 (25)		
Surgery	8	7 (87.5)	1 (12.5)		

Table 8 Patients with more than 4 instability markers (group B)

Management	Number of patients	Good outcome [*n* (%)]	Poor outcome [*n* (%)]	χ^2	*P* value
Plaster cast immobilization only	12	5 (41.6)	7 (58.3)	1.95	0.376
Manipulation	6	4 (66.5)	2 (33.3)		
Surgery	7	5 (71.4)	2 (28.5)		

Table 9 Patients' final results

Total results	Good [*n* (%)]	Poor [*n* (%)]	χ^2	*P* value
Group A	29 (82.9)	6 (17.1)	5.18	0.023
Group B	14 (56.0)	11 (44.0)		

functional results, as reported by Warwick *et al*. [18]. The poor correlation between the radiographic and functional outcomes in older people might be related to decrease functional needs on the wrist, which is thought to be associated with aging. Young and Rayan [19] Anzarut *et al*. [20] found no correlation between dorsal angulations and wrist function.

Conclusion

Unstable distal radius fractures can be reliably and anatomically reduced and stabilized using fragment-specific fixation. Fixation of markedly comminuted fractures is secure enough to allow immediate motion and does not require casting or external fixation. Anatomic reduction with early motion can be achieved in a routine fashion on unstable distal radius fractures. Patients with four or more instability markers in distal radial fractures are globally associated with a poorer outcome. Patients with four or more instability markers have better outcomes with surgery when compared with manipulation alone. Patients with three or fewer instability markers have a good outcome regardless of the management strategy used. In this study, results regarding the number of instability markers in distal radial fractures are useful in guiding management and predicting outcome. In an active, healthy patient with an unstable fracture, an attempt at anatomic reduction and fixation through surgical means is more likely to render good functional results. In a low-functioning patient with multiple medical comorbidities, conservative management is a safer option and is likely to give acceptable clinical outcomes, even with malunion. In between these two extremes, treatment decisions need to take into account more than fracture pattern and include premorbid function of the patient and medical comorbidities.

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Conflicts of interest
There are no conflicts of interest.

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